Aeration Control Using Continuous Dissolved Oxygen Monitoring In An Activated Sludge Wastewater Treatment Process

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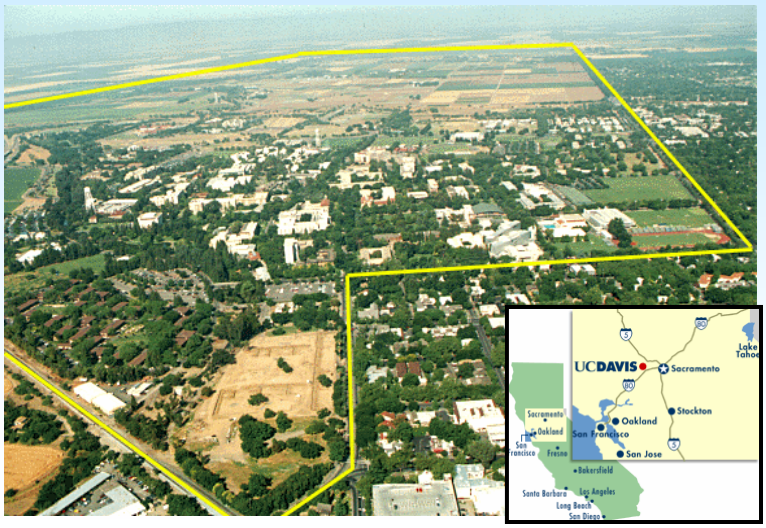
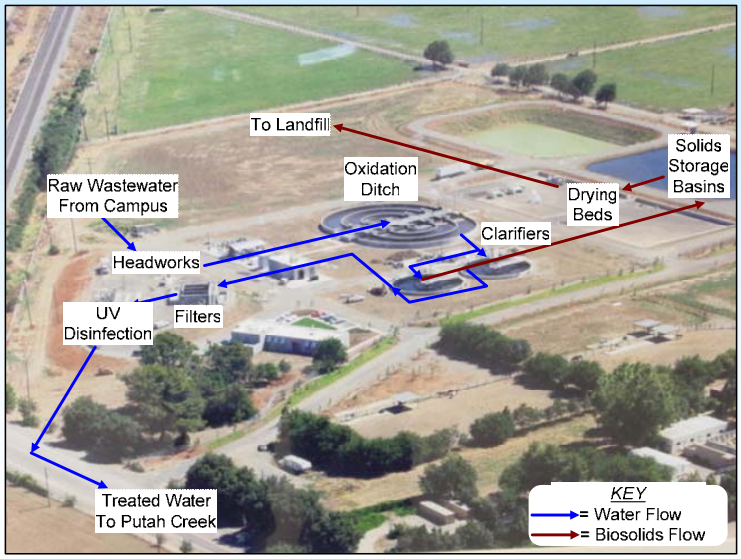
The UC Davis Campus



UC Davis WWTP Unit Processes

Process	Description
Headworks	2 Channel Monsters® and 1 Auger Monster™
Oxidation Ditch	3 channels (Orbal by U.S. Filter/Envirex Inc.)
Clarifiers	2 clarifiers
Filters	3 filters (Hydro-Clear®)
UV Disinfection	2 channels (Trojan 3000)
Solids Storage Basins	2 basins
Solids Drying Beds	2 beds

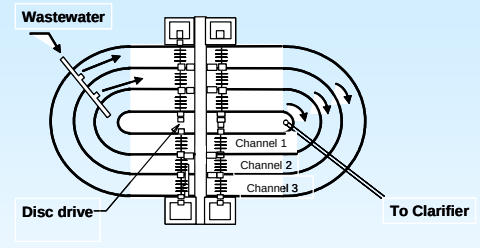
The UC Davis WWTP



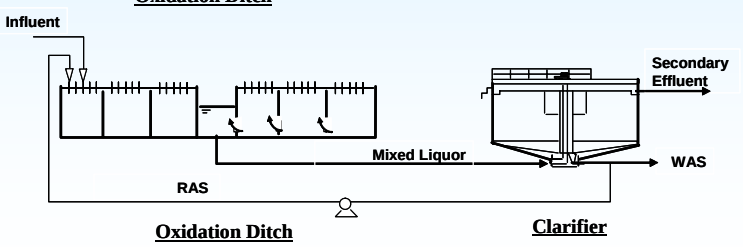
Treated Water Quality Summary

	BOD (mg/L)	TSS (mg/L)	Total Coliform (MPN/100ml)	Total N (mg/L)	Total P (mg/L)	NTU
Influent	150	160	NA	30	6	NA
Effluent	1.5	1.5	<2.2	6	2.5	<2

Oxidation Ditch Configuration

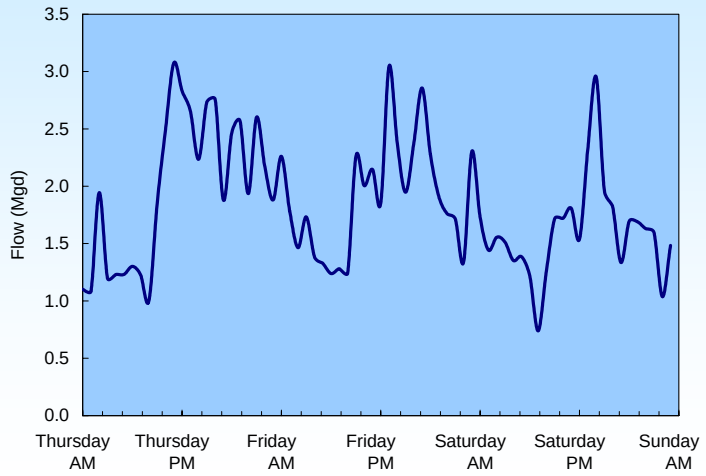


Oxidation Ditch



Oxidation Ditch Clarifier

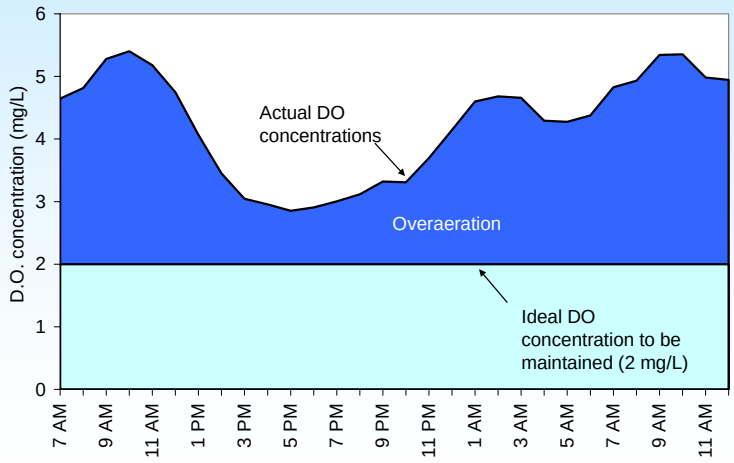
Typical Flow Patterns



Oxygen Transfer & Power Consumption (per disc)

	Base Forward		Apex Forward	
	LBS. O_2/HOUR	**BHP**	**LBS. O_2/HOUR**	**BHP**
43 RPM				
21" immersion	1.66	0.48	1.25	0.36
19" immersion	1.54	0.44	1.14	0.33
17" immersion	1.38	0.4	1.04	0.30
15" immersion	1.25	0.36	0.94	0.27
13" immersion	1.11	0.32	0.84	0.24
11" immersion	0.98	0.28	0.74	0.21
9" immersion	0.85	0.24	0.64	0.18
55 RPM				
21" immersion	2.5	0.83	1.85	0.58
19" immersion	2.28	0.73	1.68	0.53
17" immersion	2.08	0.69	1.54	0.48
15" immersion	1.88	0.62	1.39	0.44
13" immersion	1.66	0.56	1.24	0.39
11" immersion	1.48	0.49	1.09	0.34
9" immersion	1.23	0.42	0.94	0.3

DO Levels in the Innermost Oxidation Ditch Channel under Manual Aeration

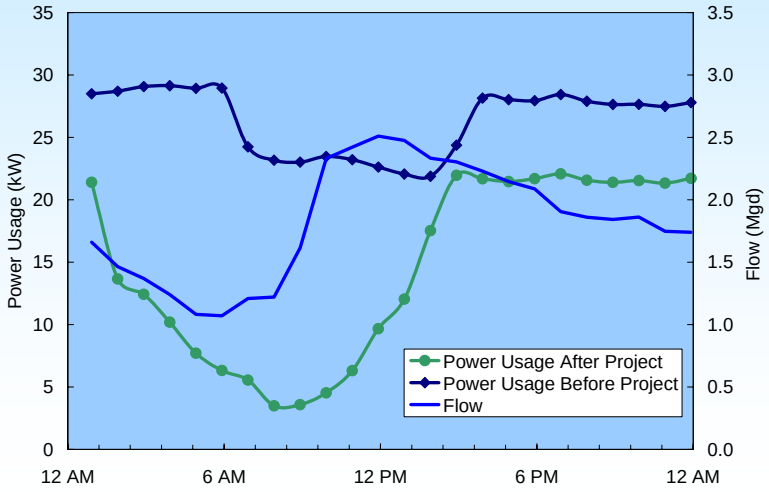


Project Scope

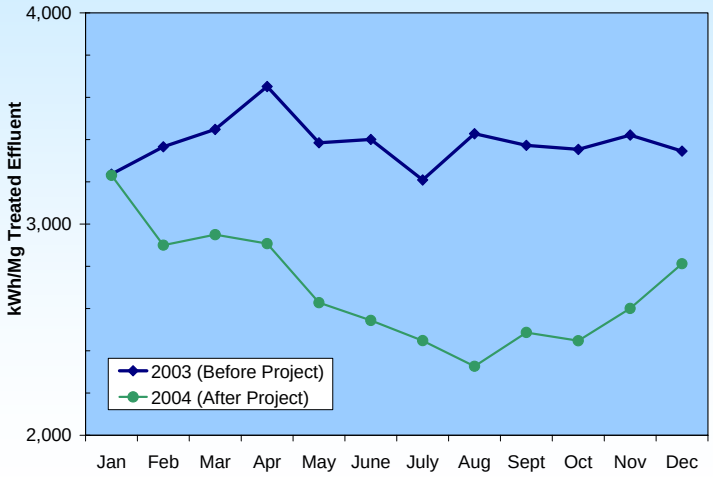
- Installation of a continuous on-line DO monitor.
- Addition of variable frequency drives on two of the aerators.
- PLC Programming to maintain aeration speed in response to DO levels.

Cerlic® Float Ball DO Monitor

Typical Electrical Use Before and After Process Control Changes



Flow-adjusted Electrical Use



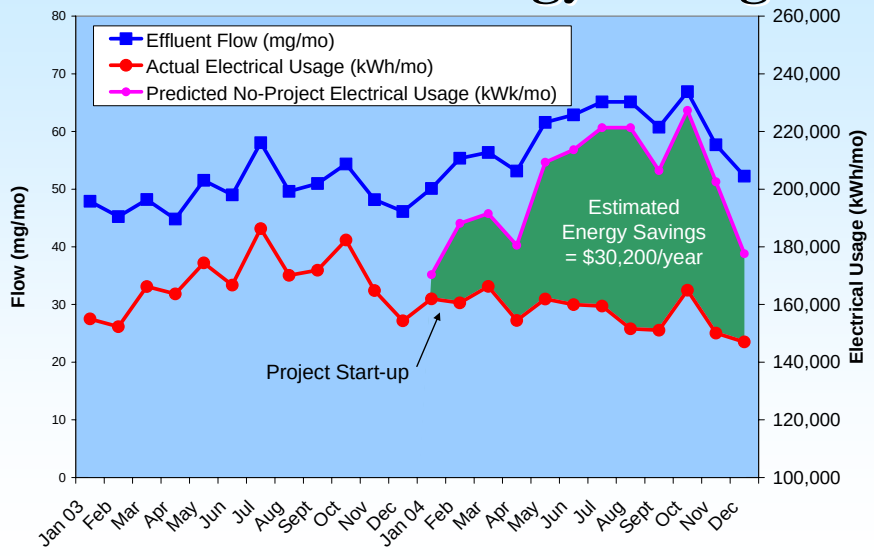
Secondary Treatment Water Quality (Prior to Filtration)

	2003				2004			
Month	TSS	Turbidity	SVI	pH	TSS	Turbidity	SVI	pH
January	8.6	2.24	60	7.62	8.0	2.55	93	7.87
February	7.0	1.95	71	7.62	11.9	3.52	112	7.55
March	7.0	2.2	68	7.68	5.2	1.56	99	7.65
April	4.8	1.71	83	7.60	4.7	1.45	162	7.62
May	5.2	1.73	85	7.99	5.3	0.33	115	7.95
June	5.8	1.97	82	7.92	8.9	2.88	106	8.04
July	5.3	1.93	76	7.96	7.3	2.24	67	8.08
August	6.5	2.04	83	7.92	11.0	2.97	67	8.00
September	8.4	2.41	75	7.97	8.6	2.64	98	8.02
October	10.4	1.87	112	7.95	8.2	1.89	89	8.05
November	7.4	2.38	111	7.98	6.0	1.69	85	7.97
December	8.19	2.53	104	8.06	6.5	2.05	89	7.96
Average	**7.05**	**2.08**	**84**	**7.86**	**7.64**	**2.15**	**99**	**7.90**

Effluent Water Quality after Tertiary Treatment

Month	2003				2004			
	TSS	Turbidity	BOD_5	NH_3-N	TSS	Turbidity	BOD_5	NH_3-N
January	0.92	1.58	1.72	<0.5	0.64	0.33	1.27	<0.5
February	0.51	0.59	1.18	<0.5	2.20	1.97	1.66	<0.5
March	1.00	0.91	1.65	<0.5	0.40	0.45	1.31	<0.5
April	1.20	1.38	1.44	0.87	0.19	0.46	0.57	<0.5
May	0.92	0.93	1.25	<0.5	0.25	0.33	1.34	<0.5
June	1.04	0.52	1.17	<0.5	0.91	0.91	2.00	<0.5
July	0.54	0.40	1.35	<0.5	0.47	0.45	1.28	<0.5
August	0.66	0.47	1.57	<0.5	0.37	0.45	1.19	<0.5
September	0.65	0.64	1.85	<0.5	0.27	0.53	0.95	<0.5
October	0.40	0.35	1.80	<0.5	0.30	0.52	1.63	<0.5
November	0.32	0.37	1.19	<0.5	0.40	0.74	2.50	<0.5
December	0.59	0.48	1.10	<0.5	1.00	0.74	1.96	<0.5
Average	**0.73**	**1.12**	**1.44**	**0.87**	**0.62**	**0.80**	**1.47**	**<0.5**

Bottom-line Energy Savings



Conclusions

- The availability of a debris-free, low-maintenance, in-line DO meter makes automatic DO loop control operationally practical for activated sludge treatment systems.
- The project has reduced WWTP electrical consumption by an average of 23% or 755 kilowatt-hours per million gallons (kWh/Mg).
- Beyond energy efficiency, the ability to maintain DO at prescribed levels in the oxidation ditch has afforded operators a higher degree of biological process control.
- The revised system was designed to consistently maintain DO at fixed levels with the goal of maintaining a stable biological treatment process.